

WHAT IS CLAIMED IS:

1. A pattern dependent jitter measuring apparatus comprising:

5 a clock generating unit which generates a clock signal having a predetermined frequency; and

a pattern generating unit which outputs a data signal having a predetermined pattern in which one frame is configured from a predetermined bit length, so as to be synchronized with the clock signal outputted from the clock signal generating unit, wherein the pattern dependent jitter measuring apparatus further comprises:

10 a waveform information acquiring unit which receives the data signal outputted from the pattern generating unit as a data signal to be measured, and receives the clock signal outputted from the clock generating unit, and which acquires information of waveform in the same time domain of the data signal to be measured and the clock signal;

15 an averaging processing unit which carries out averaging processing on the waveform acquired by the waveform information acquiring unit;

20 a phase difference detecting unit determining the per-bit phase difference between the data signal to be measured and the clock signal, based on the waveform information averaged by the averaging processing unit;

25 a frequency band limiting processing unit which

carries out predetermined frequency band limiting processing on information of the per-bit phase difference obtained by the phase difference detecting unit; and

5 a measured result outputting unit which outputs the phase difference information on which the frequency band limiting processing is carried out by the frequency band limiting processing unit, as pattern dependent jitter.

10 2. The pattern dependent jitter measuring apparatus according to claim 1, wherein the pattern generating unit is configured to include a data signal in which an unscrambled specific pattern exists at a head position of each frame, as the data signal
15 outputted from the pattern generating unit.

 3. The pattern dependent jitter measuring apparatus according to claim 1, wherein the waveform information acquiring unit is configured to receive a data signal to be outputted by a measuring object
20 which has received the data signal outputted from the pattern generating unit, as the data signal to be measured, and receive a clock signal outputted from the clock generating unit, and acquire waveform information in the same time domain of the data signal
25 to be measured and the clock signal.

 4. The pattern dependent jitter measuring apparatus according to claim 3, wherein the measuring

object includes equipment configured such that, when pattern dependent jitter is included in a data signal to be inputted, a pattern dependent jitter component included in the inputted data signal can be removed by
5 waveform shaping processing at the inside thereof, and a data signal including random noise jitter and pattern dependent jitter which the measuring object itself internally generates is outputted to the waveform information acquiring unit as the data signal to be
10 measured.

5. The pattern dependent jitter measuring apparatus according to claim 1, wherein the pattern generating unit is configured to output a frame synchronization signal synchronized with data output
15 timing at an arbitrary bit position in one frame of the data signal, to the waveform information acquiring unit, and

the waveform information acquiring unit is configured to acquire a predetermined number of frames
20 of the waveform information of the data signal to be measured and the clock signal by using the timing when the frame synchronization signal is inputted as a standard timing.

6. The pattern dependent jitter measuring
25 apparatus according to claim 5, wherein the averaging processing unit is configured to determine one frame of waveform information of the clock signal and the data

signal to be measured from each of which the random noise jitter component has been removed, by averaging the predetermined number of frames of waveform information which are acquired by the waveform information acquiring unit.

7. The pattern dependent jitter measuring apparatus according to claim 6, wherein the phase difference detecting unit is configured such that a phase difference (time difference) $\Delta T(i)$ between level displacement timing of the clock signal which is determined by the averaging processing unit, and from which the random noise jitter component has been removed, and a code boundary of the data signal to be measured, is determined for each bit, and such that per-bit phase difference $\Delta T(i)'$ is determined by

$$\Delta T(1)' = 0, \text{ and}$$

$$\Delta T(i)' = \Delta T(i) - \Delta T(1) \quad (i = 2, 3, \dots, N),$$

by correcting the phase differences $\Delta T(2)$, $\Delta T(3)$, ..., $\Delta T(N)$ from the second bit on by the bit difference $\Delta T(1)$ of the first bit.

8. The pattern dependent jitter measuring apparatus according to claim 7, wherein the phase difference detecting unit is configured such that detection of the level displacement timing is carried out after it is judged whether or not an amplitude of the data signal to be measured that is determined by the averaging processing unit exceeds a threshold

value.

9. The pattern dependent jitter measuring apparatus according to claim 7, wherein the phase difference detecting unit detects timing only when
5 a code of the data signal to be measured determined by the averaging processing unit is changed, with respect to the detection of level displacement timing, and determines a time difference between the timing and the level displacement timing of the clock signal as
10 a phase difference.

10. The pattern dependent jitter measuring apparatus according to claim 7, wherein the phase difference detecting unit is configured such that, when the code of the data signal to be measured determined
15 by the averaging processing unit is not changed, with respect to the detection of level displacement timing, a phase difference of the previous bit is allocated.

11. The pattern dependent jitter measuring apparatus according to claim 1, wherein the frequency
20 band limiting processing unit is configured to include a digital filter formed by digital signal processing means.

12. The pattern dependent jitter measuring apparatus according to claim 1, wherein the waveform
25 information acquiring unit and the averaging processing unit are configured from a sampling oscilloscope.

13. A pattern dependent jitter measuring method

comprising:

outputting a data signal which is synchronized with a clock signal having a predetermined frequency, and has a predetermined pattern of a predetermined bit length, wherein the pattern dependent jitter measuring method further comprises:

receiving the data signal as a data signal to be measured, and receiving the clock signal, thereby to acquiring waveform information in the same time domain of the data signal to be measured and the clock signal;

carrying out averaging processing on the waveform acquired by the acquiring of the waveform information;

detecting phase differences of the data signal to be measured and the clock signal, for each bit of the data signal to be measured, based on the waveform information obtained by the averaging processing;

carrying out predetermined frequency band limiting processing on the phase difference information detected for each bit; and

outputting the phase difference information on which the predetermined frequency band limiting processing is carried out, as pattern dependent jitter.

14. The pattern dependent jitter measuring method according to claim 13, wherein the outputting of a data signal outputs a data signal in which an unscrambled pattern exists at a head portion of each frame, as the data signal.

15. The pattern dependent jitter measuring method according to claim 13, wherein the method further comprises:

5 inputting the data signal which is synchronized
with a clock signal having a predetermined
frequency, and which has a predetermined pattern of
a predetermined bit length, to a measuring object, and
the acquiring of the waveform information receives
10 a data signal outputted from the measuring object which
has received the data signal, as the data signal to be
measured, and receives the clock signal, and carries
out the acquiring of the waveform information in the
same time domain of the data signal to be measured and
the clock signal.

15 16. The pattern dependent jitter measuring method
according to claim 15, wherein the measuring object
includes equipment configured such that, when the
pattern dependent jitter is included in a signal to be
inputted, a pattern dependent jitter component included
20 in the inputted data signal can be removed by waveform
shaping processing at the inside thereof, and a data
signal including random noise jitter and pattern
dependent jitter which the measuring object itself
internally generates, is outputted as the data signal
25 to be measured.

17. The pattern dependent jitter measuring method according to claim 13, wherein the method further

comprises:

outputting a frame synchronization signal
synchronized with data output timing at an arbitrary
bit position in one frame of the data signal, and

5 the acquiring of the waveform information acquires
a predetermined number of frames of waveform
information of the data signal to be measured and the
clock signal by using timing when the frame
synchronization signal is inputted as a standard
10 timing.

18. The pattern dependent jitter measuring method
according to claim 17, wherein the averaging processing
determines one frame of waveform information of the
clock signal and the data signal to be measured from
15 each of which the random noise jitter component has
been removed, by averaging the predetermined number of
frames of waveform information acquired by the
acquisition of waveform information.

19. The pattern dependent jitter measuring method
20 according to claim 18, wherein the detecting of the
phase difference detects a phase difference (time
difference) $\Delta T(i)$ between level displacement timing of
the clock signal which is determined by the averaging
processing unit, and from which the random noise jitter
25 component has been removed, and a code boundary of the
data signal to be measured, for each bit, and
determines per-bit phase difference $\Delta T(i)'$ by

$\Delta T(1)' = 0$, and

$\Delta T(i)' = \Delta T(i) - \Delta T(1) \quad (i = 2, 3, \dots, N),$

by correcting phase differences $\Delta T(2), \Delta T(3), \dots, \Delta T(N)$
from the second bit on by the bit difference $\Delta T(1)$ of
the first bit.

20. The pattern dependent jitter measuring method
according to claim 18, wherein the detecting of the
phase difference is configured such that detection of
the level displacement timing is carried out after it
is judged whether or not an amplitude of the data
signal to be measured determined by the averaging
processing exceeds a threshold value.

21. The pattern dependent jitter measuring method
according to claim 18, wherein the detecting of the
phase difference detects timing only when a code of the
data signal to be measured determined by the averaging
processing is changed, with respect to the detection of
level displacement timing, and determines a time
difference between the timing and the level
displacement timing of the clock signal as a phase
difference.

22. The pattern dependent jitter measuring method
according to claim 18, wherein the detecting of
the phase difference is configured such that, when
the code of the data signal to be measured determined
by the equalization processing is not changed, with
respect to the detection of level displacement timing,

a phase difference of the previous bit is allocated.

23. The pattern dependent jitter measuring method according to claim 13, wherein the acquiring of the waveform information and the averaging processing are
5 carried out by a sampling oscilloscope.